Tensile and flexural properties of a newly developed bulletproof vest using a kenaf/x-ray film hybrid composite

ABSTRACT

In terms of manufacturing cost and weight, current bulletproof vests are simply not optimized. This means that consumers and manufacturers alike desire a bulletproof vest that is more user-friendly, cheaper, and lighter. This study considered the tensile and flexural characterization of new lighter and cheaper hybrid composite materials to replace the existing insert panel for the currently available bulletproof vest. The materials chosen included a natural fibre, i.e., kenaf fibre, chemically treated with sodium hydroxide solution, and, as a means of recycling, used x-ray films with a surface treatment. Using the traditional hand lay-up method, the materials were fabricated into seven layers of different configurations, which were then subjected to tensile and flexural tests. The findings showed that one of the configurations that consisted of both treated materials had a tensile strength of 396.9 MPa, which is quite strong, and a flexural modulus of 6.24 GPa, which makes it flexible enough to be made into wearable equipment. This configuration was then chosen to be the base design for the specimen subjected to impact test. The interfacial bond between the two distinct materials proved to be a major issue, even with the help of fibre treatment. Therefore, some improvements need to be made for the material to be comparable to existing materials performance-wise hence making this configuration suitable for ballistic application. However, the design did show promising results by stopping a bullet with speed up to 230 m/s.

Keyword: Kenaf fibre; X-ray; Chemical treatment; Surface treatment; Tensile test; Flexural test; High-velocity impact test